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Technologies of exposure: videoconferenced Distributed Medical Education as a sociomaterial practice

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Abstract

Context

Distributed medical education (DME) often involves delivering curriculum to geographically separate campuses via videoconferencing technologies. Videoconferencing, a network of buttons, screens, microphones, cameras, and speakers, is one way to ensure that undergraduate medical curricula are comparably delivered across sites, a common requirement for professional accreditation. However, little has been written that critically explores the role of videoconference technologies in day to day DME.

Methods

This paper is based on a three-year ethnographic study of a Canadian distributed undergraduate medical program. Drawing on observations (n=108 hours), interviews (n=33) and document analysis (n=65), the authors ask: How do videoconference technologies transform the everyday practices of DME?

Results

The authors describe three interconnected ways that videoconference systems operate as unintended "technologies of exposure" in DME: as visual, curricular, and auditory exposures. Videoconferencing inadvertently exposes both mundane and extraordinary images and sounds, offering access to the informal, unintended and often intimate curriculum of everyday medical education. The authors conceptualize

these exposures as sociomaterial assemblages, and recognize they add an additional layer of learning and labor for members of medical school communities.

Conclusion

This analysis challenges the assumption that videoconferencing merely extends the bricks-and-mortar classroom. The authors explore far-reaching and unintended consequences within DME, and recommend more critical consideration of the ways videoconference shifts the terrain of medical education. These findings point to a need for more critically oriented research exploring the ways DME technologies transform medical education, in both intended and unintended ways.

Introduction

Distributed medical education (DME) involves delivering curriculum to geographically separate campuses. The Association of Faculties of Medicine of Canada defines DME as "a decentralized model of health education using a teaching and learning network that is integrated in and accountable to communities" (1). While there are many models of DME, a common factor is that technological interventions connect multiple sites at various points (2). Increasingly, DME lectures and other large group activities are facilitated by videoconferencing, which we will henceforth refer to as VDME. We recognize that DME is a broader endeavour with goals of building capacity in rural settings, addressing issues of equity by providing community access to medical education, maximizing economic investments, among others; however, these issues were not the focus of our work. Rather, our sociomaterial ethnography had a specific focus on understanding the practices of VDME.

Videoconferencing has been defined as "a collective of technologies utilized to transfer digitized data in the form of images and audio, including video clips, photographs, music and other information" (3: p. 90). With more than 30 years of history in higher education, videoconferencing systems have allowed for curriculum to be delivered from one location to multiple physical classrooms at one time (4). In the context of medical education, videoconferencing extends curriculum to learners at regional campuses, helping to ensure a comparable educational experience (5).

With its elaborate, studio-based delivery through high-speed broadband networks, videoconferencing in higher education has been lauded for its affordance of instant interaction (4). It has been described as "a superior distance-education technology for … disciplines in which interpersonal skills are a large component of the students' education" (6: p. A24).

The rapid pace of emerging technologies has meant that distance learning tools, like videoconferencing have remained undertheorized (4, 7, 8). Scholarship related to videoconferencing in DME requires a critical perspective that unsettles taken for granted notions about these technologies as neutral backgrounds to human interaction. We believe the tools, spaces and processes of videoconferencing--buttons, screens, cameras, michrophones--should be rigorously examined as central actors that facilitate, restrict and complicate medical education (3). Our perspective echoes that of Löglund (3) who describes videoconferencing as a practice constituted through human and non-human actors. This perspective, however, has not been widely applied in medical education, with the majority of research on videoconferencing describing student satisfaction, and a smaller number of studies learning outcomes across various sites (5).

In 2010, our undergraduate medical education program began formally delivering curriculum to two campuses using videoconferenced distributed medical education (VDME). As observers of this process, and as users of the VDME technologies, we were impressed by their affordances, reliability and utility. Almost without fail,

learners who were separated by 100s of kilometers were brought together to simultaneously participate in shared learning experiences. And yet, we also noticed that in addition to connecting learners, the VDME technologies did other, unexpected things. While people were certainly able to access content through the VDME system, we also noticed that they were also developing strategies to avoid it, sometimes surprised by it, and often finding ways to work around it. The technologies didn't seem to be a neutral backdrop for learning, but rather a central mediating factor in the learning experience. With this in mind, we decided to systematically explore how the human and non-human elements come together to produce VDME. Our exploration took the form of a three-year sociomaterial ethnographic study.

This manuscript, reporting on findings from our ethnographic work, discusses three types 'exposures' we observed in our field work: 1) visual; 2) curricular; and, 3) auditory. We take the position that these exposures are the product of the sociomaterial practice of VDME, meaning messy collections of people and things "producing intended and unintended outcomes" (9: 1445). The value in considering VDME as a sociomaterial practice is that, in directing our inquiry toward the material elements of the learning environment, we were able to problematize taken for granted discourses of "seamlessness" that have often been associated with videoconferencing and VDME. Yes, distributed campuses can, and do, connect through VDME. However, in taking a sociomaterial approach, we see that much

more than connection is actually happening, including the exposures we document herein.

Theoretical Frame:

Our ethnographic research was theoretically framed in sociomaterialism (10), a diverse body of theoretical work. This framework facilitated an analysis of the entanglement of the material aspects of the learning environment (e.g. technology, classroom spaces) with the social elements (e.g. relationships, interactions) in VDME.

Sociomaterialism is an umbrella term for a variety of approaches that consider both social and material elements (9). In the context of our research, we drew on the following principles of sociomaterialism: 1) that material elements are as important as discourse and language; 2) that the social and material are inseparable; 3) that social and material elements do not have intrinsic properties outside of their interaction; 4) that the line separating social and material elements is abstract and artificial; and 5) that research must therefore focus on practices (9, 11).

Beginning from the position that social and material actors are symmetrical elements (i.e. equally important), our work shifted the emphasis from traditional studies of DME, which have focused exclusively on human concerns. In taking a

sociomaterial perspective, we theorized videoconferencing technologies not as the backdrop for learning, but rather as agents that "work" to produce DME.

Methods

Research setting:

Since September 2010, the undergraduate program in the Faculty of Medicine at Dalhousie University has been fully distributed across two campuses: the original site in Halifax, Nova Scotia (80 students per year); and, Dalhousie Medicine New Brunswick, 400 kilometers away in Saint John, New Brunswick (30 students per year). In order to be seen and heard across sites, people rely on of videoconference technologies.

The main lecture theater in Halifax has three 78"x140" projection screens and three projectors. The connection is facilitated through a videoconferencing control system, 52- inch main displays and 40-inch confidence monitors (monitors only visible to the instructor). There are a series of cameras covering the classroom, gooseneck microphones at the lecture podiums and microphones on student desks that are managed through high speed processors, and a collection of speakers in the ceiling. The equivalent classroom in Saint John is smaller and equipped with the same technologies.

Sociomaterial ethnography:

In order to explore videoconferenced DME in detail, we conducted a sociomaterial ethnography. This meant that we 1) studied the assemblage of social and material rather than focusing exclusively on social constructions; 2) attuned to emerging practices and performativity rather than focusing on social or cultural representations; and, 3) considered the researcher as part of the assemblage being studied rather than focusing on "insider/outsider" status (12).

Role of the researchers:

Sociomateriality positions researchers as constitutive elements of the phenomenon being studied, and thus, as mediating features of the research setting. In this light, we recognize that our observations of the videoconferencing materials were both constraining and enabling, which, in turn, influenced our data collection and analysis. In other words, we believe that the phenomenon of VDME was not stable, passively waiting for us to observe, but rather that we influenced, and in fact, became part of the practices we observed. This was especially true for those of us who are educators who have used the VDME system in our teaching, as separating our reflections on our teaching from our field notes was difficult and somewhat artificial.

Data collection:

We used a progressive suite of data collection strategies with the goal of developing rich description of videoconferenced DME. We collected both formal and informal data at two campuses between 2013-2015.

Three researchers produced detailed field notes describing the material context of the various spaces of videoconferenced DME. These notes were supplemented with manufacturer product descriptions of the technologies. We also collected a set of photographs of the videoconferencing spaces and tools. In addition to this visual data, we recorded informal field notes and memos in real time during observations.

In terms of documenting human interactions with the videoconferencing materials, our formal data included:

1) *Critical Textual Analysis:* Three researchers conducted an environmental scan to identify documents and policies related to DME. This included internet searches and consultations with key informants. In sum, we identified and reviewed 65 texts related to DME in our local context. These included strategic planning documents, accreditation documents, local technology policies, instruction manuals for teachers, technological guidebooks, and guiding curriculum documents. We developed and used a document review form which focused on implicit messages and positioning of the DME program.

2) *Observation:* We developed an observation guide that encouraged the observer to take into account both the social and material features. The template served as a reminder of the elements to consider in observations,

and left considerable space reflection and observation. A team of six researchers used this template to conduct observations over 18 months; however, three core researchers conducted the majority of the observations.

Our ethnography focused on the videoconferencing technologies mediating DME; therefore, the observations centered around the technologies. This meant that all observations took place in classrooms or meeting rooms equipped with videoconferencing tools. We generally observed undergraduate medical education lectures; however, we also observed extracurricular events, conferences, and meetings. We conducted a total of 108 hours of observation.

3) *Interviews:* Following observations, we conducted 33 in-depth, semi-structured interviews with faculty, administrative staff, audiovisual professionals and students. Rather than focusing on exploring perspectives and social relations, our interviews were designed to further our understanding of videoconferenced DME. Specifically, interviews with faculty focused on the logistics of teaching with videoconferencing technologies (n=7). Those with administrative staff focused on planning the DME program to coordinate with the videoconferencing tools (n = 5). Interviews with AV professionals focused on functionality of the videoconferencing system (n=6). Finally, interviews with students focused on learning in a videoconferenced environment (n=15).

Data analysis:

Our approach to data analysis was iterative. Our analyses focused on understanding the ways in which the technologies worked to expose members of the medical school community to be able to see and hear things that would not have otherwise been accessible.

We worked with a modified version of Wolcott's description, analysis, and interpretation approach (13), with the explicit addition of a focus on the mediating role of the VDME system. This approach allowed us to iteratively capture and analyze themes, while providing the flexibility to explore emerging practices and performativity.

We managed the challenges of employing classical data collection strategies within a post-humanist orientation, like sociomaterialism, through consultation and discussion.

Practically speaking, we considered each data source individually in order to develop a coding framework. We then applied these frameworks and independently coded and analyzed the data by method (text, observation, interview) and then interpreted data for the project as a whole. Qualitative data analysis software (ATLAS.ti version 7.0) was used to manage, code, and share data. Three researchers took the lead on coding the data, and shared their interpretations and analysis with

a larger group for consideration. Discord was minimal, and was managed by discussion.

Ethics:

This research was approved by the Dalhousie University Social Science and Humanities Research Ethics Board.

Results:

Over the course of our field work, it became clear that in addition to connecting regional campuses for educational purposes, the videoconferencing technologies accomplish other, unintended work. Frequently, this unintended work took the form of "exposures" which the Oxford Dictionary defines as "the revelation of an identity or fact, especially one that is concealed or likely to arouse disapproval" (14). We identified several such exposures, and classified them as visual, curricular or, auditory.

Visual exposures:

Many of the exposures we documented in our data were "visual" in nature, afforded by the cameras and/or screens of DME spaces. These visual exposures occurred on large, high-definition screens, magnified in such a way that the exposure is literally "larger than life." Without exception, our interview participants described feeling uncomfortable, to some degree, with being on "the big screen." Likewise, incidents

of people appearing to be self-conscious or embarrassed on the screen, or attempting to move out of view of the camera, were well described in our field notes.

While people using the VDME system understood that their image would be projected on a screen, the sheer size and degree of detail that was projected was surprising, and even alarming for some.

> *I sent [a friend at another campus] a photo once of how big they are [on screen]… And he, like, couldn't believe it. … I think that they forget that they're that big*.
>
> -Student

> *As a lecturer, I was really shocked! shocked! by how exposed I felt being behind the fancy new technogizmo lectern system. … It was very hard to get a sense of where my body started and where it stopped. It was everywhere! I could see my body on several screens, including in front and behind me. I was seen at local and satellite sites from multiple angles and it is anxious making. In addition, I know I was being taped. Not to mention that there are people in the control room ensuring that technologically all goes OK. I felt like saying, "Does the camera add x number of pounds?" Everyone is watching and I felt super conscious.*
>
> -Field note from lecturer

This discomfort was amplified by the element of surprise. For example, people sometimes ended up on the screen when they were not expecting it. This happened because people were unwittingly in the frame of the camera shot as a question was being asked; however, it was not unusual for people to unintentionally 'hit' the button that activates a camera.

> *So if someone puts their laptop down [in a certain way], it triggers the button. And a lot of people have just done it by mistake. So it usually happens maybe a couple of times a month that someone [on either campus] comes up on camera and they're just so unaware that they're on camera.*
>
> -Student

The videoconference system allowed for people at one campus to passively 'watch' those at the opposite site as they were projected onto the large, high definition screen. In conversations with students, it became clear that the screen somehow changed the way classmates 'looked' at each other.

> *And sometimes you're like, oh my god, I'm being so creepy. Like they're over there and the lecturer is over on the other side. So it's quite obvious if you're making a choice to look at them.*
>
> -Student

In a typical face-to-face encounter, social norms dictate the amount of time that is appropriate to look at another person. In the context of VDME, the technologies can create a degree of removal, dulling or even obscuring the humanity of colleagues and classmates by rendering them two-dimensional. This, in turn, allowed participants to passively watch fellow students or lecturers on the screen, as you might watch a television.

Complicating this is the fact that people in VDME settings can never know for certain whether they are being observed at any given moment. While this can mean greater self-consciousness in many cases, the ever-present cameras can also become mundane and therefore easily forgotten.

Curricular exposures

Another type of unintended work made possible through videoconferencing is "curricular exposures." These are related to distributing curricular content, including lecture slides, photographs, teacher commentary, and other educational artefacts, across geographic sites. One such incident was described to us by an audiovisual professional:

> *So we had a clerkship session that was dealing with some aspect of human sexuality… And so we had a couple of rooms set up for the session…. And there were some relatively explicit materials that were being shown as part of the educational experience. And no one communicated to anyone [at other site]*

that that was going to occur. So there were people walking into rooms that were misbooked. And you're walking into what was relatively hard-core pornography…

In the incident described above, clerkship students had been briefed in advance about the nature of the curriculum; however, other members of the medical school community at various distributed sites were overlooked. This meant other students, faculty and staff were taken by surprise, and were an unanticipated "captive audience" of the explicit images.

The nature of medicine and medical education means that other graphic materials, including diseased organs, surgical procedures, and images of violence, to name but a few, are necessary curricular components. Videoconferencing technologies opened what were once the closed doors of the medical education lecture theatre, potentially exposing this content to audiences beyond the medical student. One of our researchers experienced such an exposure, sitting in on a lecture to take field notes.

It's bad enough to have to look at a skin malignancy. But seeing it on the big screen is pretty intense. It's literally bigger than me. I'm so squeamish. I keep trying to look away, be cool, thinking I didn't go to grad school for this…
-Field note

The audiovisual professionals working behind the scenes to facilitate the delivery of curriculum are particularly susceptible to these exposures. Due to the nature of their work; however, they are sometimes in positions where they are not able to 'close their eyes' to avoid it.

> *They were made known in advance of becoming part of this team that they would be privy to some information, there would be some things that they may see that may be disturbing. And you know, we've let them know that they can kind of opt out. But if you have one person responsible and they're the only one there, and they're not comfortable… What do they do?*
> -Audiovisual Professional

In other words, the sociomaterial elements producing VDME leads to curriculum being broadcast in high definition to people other than the intended audience.

Auditory exposures:

Videoconferencing also allows for auditory exposures, as people hear and are heard, intentionally and unintentionally, by students, lecturers, meeting attendees and audiovisual professionals across sites. Distributed learning spaces are equipped with many microphones which are found on tabletops or desktops, at podiums, and in ceilings. Perhaps due to the omnipresence of these mics, members of the DME community seem to lose sight of the fact that they can be, and frequently are, heard by people who are not physically present in the same physical place. For example,

one field note described a meeting attendee in a room at a distant site not realizing his microphone had been activated during a faculty meeting:

> *I can hear him breathing into the microphone. It sounds like when someone puts the telephone too close to their face. Everybody's kind of uncomfortable in this room. We all hear it but he has no idea.*

The audiovisual professionals working behind the scenes, whom we have previously described as largely invisible actors in DME (15), have potential visual and auditory access to all lecture and meeting spaces at the medical school and therefore have ample opportunity to "overhear." For example, when we asked an audiovisual professional whether he received feedback on the functionality of the videoconference system he told us he did not; however, he qualified the statement by saying the following:

> *We overhear a lot of what goes on in the classroom. So we get feedback through that means.*
> -Audiovisual Professional

The fact that the technologies are designed to optimize hearing across sites has been the source of some challenging situations, potentially exposing communications that were intended to be private. This has occurred in smaller settings, like meetings, and also on a larger scale, as described in an interview.

There was a panel. And following the panel, there was a discussion going on about something that was taking place in the class. There was some sort of rift forming with some of the students, and tempers were beginning to flare a bit. The students are very comfortable in the classroom, and they know when their light is not on, their mic is not on. So they knew full well that their microphones were not on but they forgot that the panel was active. And what was clearly intended to be a private conversation was going on. And the voice was actually being piped into [the large group lecture].

-Audiovisual Professional

Auditory exposures are relatively common in DME contexts. Being heard was mediated through the assemblage of buttons, microphones, and AV professionals behind the scenes.

Discussion:

Videoconference technologies largely enable a comparable educational experience across multiple sites. However, our data analysis describes an interesting phenomenon in which the technologies, in their effort to deliver on the promise of comparability, afford members of the medical school community the ability to see and hear things that would have been invisible and/or inaudible in a single site program. These exposures are produced through the social and material actors

involved in constituting DME (cables, cameras, classrooms, curriculum, lecturers, microphones, screens, speakers, students). Such exposures may be dismissed as incidental without using a sociomaterial lens. Our position is that exposures are not accidents or meaningless. Nor are they isolated moments in time that could have been avoided if only we'd 'done a better job' or used a more advanced type of technology; rather, they are the unavoidable actuality of the multiple agential human and non-human actors coming together to produce videoconferenced DME.

Many scholars have recognized the important roles of both humans and things (tools, technologies, classrooms) in teaching and learning (3, 16, 17). However, we in medical education have traditionally conceptualized the social and the material as distinct elements. In this binary articulation, things, or materials, have been discursively constructed as passive and dependent, existing only to be activated by humans (18). This bifurcated ontology allows for an exaggerated sense of human control (19) with respect to DME. It positions humans, in our case medical educators, audiovisual professionals, and medical students, as 'authorities' who seamlessly use videoconference technologies to accomplish comparable educational experiences. In this view, videoconferencing technologies are simply tools to be used by humans to provide a controlled experience of formal curriculum for other humans. Our position is that this binary approach is not reflective of the reality of VDME, where technologies do things humans did not intend for them to do. VDME is thus a messy amalgam of heterogeneous social and material factors in constant motion working beyond human intent, a sociomaterial practice.

Our position is that each exposure we described emerged as the product of a heterogeneous array of humans and non-humans assembling. We agree with Bergson (20), Introna (19) and Whitehead, (21) that there are no distinct social and material elements constituting these exposures, rather each exposure is constitutively entangled (9). Likewise, we believe the humans actors are not the privileged 'users' of the material elements. Rather, we conceptualize the VDME as a process of on-going "becoming" which achieves certain accomplishments; some of which are intended by humans and enduring (connecting campuses across distance), while others fall outside human intent and are be fleeting (auditory, visual, and curricular exposures).

The human and non-human elements constituting DME visually and audibly link and "extend" curriculum to geographically separate classrooms. At the same time, however, this technological attempt at connection has far-reaching implications for both the formal and informal medical education that were not intended.

Videoconferencing makes visible/audible encounters that would otherwise have been invisible/inaudible in traditional face-to-face education. The human actors in a VDME context (students, lecturers, audiovisual professionals, and others) can never be certain when or if they are being observed or overheard. That is, the omnipresence of videoconferencing technologies affords a degree of exposure that

complicates the learning environment in unanticipated ways that would not have been the case in traditional face-to-face medical education.

This is not to say that there are no exposures, or other unintended occurrences, in face-to-face medical education. However, the nature of the elements producing videoconferenced DME, and therefore the exposures themselves, are different. Certainly, being watched on a 78"x140" screen is different than being watched across a classroom (22). Likewise, being overheard by virtue of physical closeness is different than having your voice unknowingly projected into a space hundreds of kilometers away.

Relatedly, we believe that there is no 'right' technological solution for VDME. Exposures are not the product of a particular technological element, but rather constituted through the heterogeneous elements of the practice of VDME. In other words, no matter how 'state of the art' our videoconferencing tools become, VDME is the product of human and nonhuman elements becoming entangled in ways we could not have predicted to produce both intended and unintended outcomes, including the exposures we have described.

Implications for Medical Education:

This paper advances DME research by offering a critical perspective on the often taken-for-granted videoconference technologies that make it possible. What are the

potential implications for the practice of VDME? We believe there are both practical and scholarly implications to consider.

From a practical perspective, we could suggest a number of steps a program using VDME might consider. The elements producing videoconferenced DME add layers of possible exposure to the classroom, potentially opening the proverbial doors of the once closed lecture theatre. Notions of privacy and control that are implicit in traditional face-to-face learning are altered in the context of videoconferenced DME. The possibility of being indirectly watched, subject to uncomfortable curricular materials, or overheard in a private conversation existed in a traditional setting; however, these possibilities were minimal. The affordances of videoconferencing technologies, on the other hand, facilitate exposures, exposing the everyday intricacies and realities of medical education to people near and far. We believe that there are both ethical and professional considerations associated with these exposures. Relatedly, we encourage programs using VDME to explicitly address these considerations (e.g. What should I do if I overhear a private conversation through the VDME system?; What should I do if I notice someone is on screen but not aware of it?) with their students, staff and faculty members.

As a general practice, we encourage regular orientation, and re-orientation, to the VDME technologies and their affordances. This orientation should be tailored for both regular and periodical users. Rather than making this orientation a "one off," face-to-face opportunity, we suggest making this available as a short video or hand-

out that could be updated as changes are made to the system and distributed periodically, or on an 'as-needed' basis.

With respect to visual exposures, we noted that people felt most exposed when they appeared on screen unexpectedly. Relatedly, we suggest consulting with AV professionals to adjust the camera range to focus only on the person asking the question. Likewise, consulting with AV professionals is helpful to consider options for minimizing inadvertently being placed in the question queue due to accidental button-pushing.

With respect to curricular exposures, we encourage curriculum developers to think about the broadness of the VDME community. While health professionals or biomedical scientists may be somewhat desensitized to graphic curricular materials, others who help to produce VDME, including administrators and AV professionals, may find these resources upsetting. Including a 'trigger warning' and/or an 'opt out' option where possible, may help.

With respect to auditory exposures, we believe it is essential to remind users that their conversations are potentially always being overheard, and even shared. We believe working collaboratively with AV professionals to develop a 'signal' indicating that microphones are activated would be useful. Rather than making this a subtle indicator, we suggest making it obvious and easy to identify, even for those who are less familiar with the VDME technologies.

We make these suggestions in an effort to perhaps reduce the uncomfortableness associated with being exposed, or being exposed *to,* through VDME. Yet, we want to state clearly that we do not believe there is a way to predict all possible exposures or even to 'get it right.' We believe that there is no technological or educational solution that will eliminate the possibility of unintended exposure. Rather, in theorizing VDME as a sociomaterial practice, we recognize that there will always be an element of unpredictability when human and non-human elements assemble.

Certainly, we are not implying that videoconference technologies are somehow "bad" or sounding the alarm that we need to be wary and watchful when in their presence (although this is probably wise). Likewise, we recognize the legitimate institutional goal of comparability, and the affordances of videoconference technologies in making this possible. We do, however, believe it is critically important to consider the ways in which videoconference technologies have altered the social, physical, cognitive, and emotional spaces of DME programs, and, relatedly, how this shift shapes the ways in which people--students, lecturers, administrators, audiovisual professionals alike--experience and engage in medical education.

VDME is not simply an extension of in-person classroom learning. The context is changed for learners, teachers, and other members of the medical education community. Thus, from a scholarly perspective, we believe research and theorizing

of VDME must evolve to a critical orientation that takes into account the unintended and unanticipated ways in which VDME reconfigures education. It is our position that videoconference technologies significantly change the experience of teaching and learning, adding a new layer of complexity to medical education.

Taking a sociomaterial approach to considering VDME allows us to pay attention to what is happening beyond simply connecting different spaces. In shining a light on the ways in which humans and non-humans produce VDME, we can see that social and material elements sometimes come together in ways that were neither predictable nor intended. Rather than chalking this up to having a videoconference system that 'doesn't work,' taking a sociomaterial approach reminds us that there will always be an element of unpredictability, and in this unpredictability, perhaps exposure, associated with VDME.

Limitations:

This study took place in one DME program. While we believe our insights are transferrable to other medical and health professional schools using videoconferencing to connect sites, the exposures we describe are limited to our specific context.

Contributors:

AM contributed to the conception and design of the study, and to the acquisition, analysis and interpretation of data, and drafted the paper. PC contributed to the analysis and interpretation of data and contributed substantial revisions. OK contributed to the acquisition, analysis and interpretation of data and revision of the manuscript. JT contributed to the acquisition, analysis and interpretation of data and revision of the manuscript. All authors contributed to the critical revision of the paper and approved the final manuscript for publication.

References

1. Association of Faculties of Medicine of Canada. Mapping undergraduate distributed medical education in Canada. 2010:1-23.
2. Snadden D., Bates J. Expanding undergraduate medical education in British Columbia: a distributed campus model. CMAJ. 2005;173(6):589-590.
3. Lögdlund U. Constructing learning spaces? Videoconferencing at local learning centres in Sweden. Stud Cont Ed. 2010;32(3):183-199.
4. Lawson T., Comber C., Gage J., Cullum Hanshaw A. Images of the future for education? Videoconferencing: A literature review. Technol Ped Ed. 2010; 19(3): 295-314.
5. Vaccani JP., Javidnia H., Humphrey-Murto S. The effectiveness of webcast compared to live lectures as a teaching tool in medical school. Med Teach. 2016;38(1):59-63.
6. Olsen F. Videoconferencing with some life in it. Chronicle Higher Ed. 2003;49(43):A24-A25.
7. Collis B., Peters O., Pals N. Influences on educational use of the www, email and videoconferencing. Innov Ed Train Int. 2000;37:108-119.
8. Deadman P., Hall GB., Bain T., Elliot L., Dudycha D. Interactive GIS instruction using a multimedia classroom. J Geo High Ed. 2000; 24:365–380.
9. Orlikowski WJ. Sociomaterial practices: exploring technology at work. Org Studies. 2007;28(9):1435-1448.

10. MacLeod A, Kits O, Whelan E, Fournier C, Wilson K, Power G et al. Sociomateriality: a theoretical framework for studying distributed medical education. Acad Med. 2015;90(11):1451-1456.
11. Jones M. A matter of life and death: exploring conceptualizations of sociomateriality in the context of critical care. MIS Quarterly. 2014;38(3):895-925.
12. Niemimaa, M. Sociomaterial ethnography: taking the matter seriously. In Mola L., Carugati A,. Kokkinaki A., Pouloudi N., (Editors). Proceedings of the 8th Mediterranean Conference on Information Systems; 2014 September 3-5; Verona, Italy. CD-ROM. ISBN: 978-88-6787-273-2.
13. Wolcott H. Transforming qualitative date: Description, analysis and interpretation. London: Sage, 1994.
14. Oxford Living Dictionary [Internet]. 1st ed. Oxford Online Dictionary. 2017. [cited 16 June 2017]. Available from: https://en.oxforddictionaries.com/definition/us/exposure
15. MacLeod A, Kits O, Mann K, Tummons J, Wilson KW. The invisible work of distributed medical education: exploring the contributions of audiovisual professionals, administrative professionals and faculty teachers. Adv Health Sci Ed. 2016; 29:1-6.
16. Fenwick T. Sociomateriality in medical practice and learning: attuning to what matters. Med Educ.. 2014;48:44-52.
17. Mulcahy D. Thinking teacher professional learning perfomatively: a socio-material account. J Ed Work. 2012;25(1):121-139.

18. Leonardi P. When flexible routines meet flexible technologies: affordance, constraint, and the imbrication of human and material agencies. MIS Quarterly. 2011;35(1):148-167.
19. Introna L. Epilogue: Performativity and the becoming of sociomaterial assemblages. In: De Vaujany F, Mitev N, editors. Materiality and space: organizations, artefacts, and practices. NY: Palgrave Macmillan; 2013. P. 330-342.
20. Bergson H. Matter and Memory. 8th ed. Cambridge MA:MIT Press; 2005.
21. Whitehead A. Process and reality: an essay in cosmology, NY:Free Press; 1978.
22. Land R., Bayne S. Screen or monitor: issues of surveillance and disciplinary power in online learning environments. In: Land R, Bayne S, editors. Education in cyberspace. NY: Routledge; 2005. p. 163-178.